NISTTech

Apparatus and Method for Enhancing the Electromagnetic Signal of a Sample

Increases measurement sensitivity

Description

The invention is the addition of an auxiliary layer to a sample/substrate that increases the sensitivity of a spectroscopic measurement by one to three orders of magnitude. The auxiliary layer has a prescribed thickness that depends on the wavelength of interest, in the ultraviolet, visible or infrared portions of the spectrum. The auxiliary layer, which destructively minimizes one of the reflected waves, is added to the sample or substrate layers, resulting in enhanced measurement sensitivity in both ellipsometric and reflective spectroscopic apparatus.

Applications

- **The improved substrate is likely to be used as an accessory in spectrometers, ellipsometers, reflectometers and I-R imagers for:**
  Characterization of extremely thin films; characterization of inter-diffusion and depth profiling in multi-layer systems; measurement of polymer orientation in extremely thin films; in-situ measurement of polymers, proteins and cell adsorption.

Advantages

- **High signal-to-noise ratio**
- **Low cost**
- **Not limited to a specific region of the optical spectrum or to a glass substrate**
- **Higher sensitivity not limited by substrate thickness**

Abstract

Through modeling study we first noticed that the sensitivity of ellipsometry measurement of polymer thin films reached a maximum at certain film thickness; later on we realized that this high sensitivity could also be achieved when part of the polymer film thickness was substituted with a silicon oxide layer. The subsequent theoretical and modeling study demonstrated that this oxide layer (i.e. the auxiliary layer, assisting layer or sensitivity enhancement layer) needed to be at a specific thickness in order to maximize the sensitivity over a given spectral bandwidth. We have purchased and made a series of silicon wafers with auxiliary oxide layers at certain designed thicknesses and the abovementioned notion was successfully validated. In addition, we noticed that liquid cells based on reverse incidence spectroscopic ellipsometry will also benefit from this discovery. This technique can bring a significant improvement in the measurement accuracy and precision in spectroscopic ellipsometry and reflective spectroscopy through a spectral region from IR to Vis and UV.

Inventors

- Wu, Wen-Li
- Kang, Shuhui

References

- Serial #12/787,702 dtd 5/26/2010; pub #US 2010-0315627 A1 dtd 12-16-2010; Expires on 12/16/2030
- Docket: 09-013

Status of Availability

This invention is available for licensing exclusively or non-exclusively in any field of use.

Last Modified: 02/25/2011